

Applicant: Andrew J. White
For: HERMETICALLY SEALED PRESSURE-BALANCED
ACCUMULATOR

1 1. A hermetically sealed pressure-balanced accumulator comprising:
2 a housing;
3 a moveable divider mechanism for separating said housing into at least an
4 accumulator chamber at a pre-selected accumulator pressure, a first balancing chamber
5 responsive to changes in ambient pressure for adjusting said pre-selected accumulator
6 pressure with respect to ambient pressure, and a second balancing chamber responsive to
7 said first balancing chamber, said first and second balancing chambers maintaining a
8 predetermined pressure differential between said pre-selected accumulator pressure and
9 ambient pressure; and
10 a hermetic sealing device for sealing said first balancing chamber from at
11 least one of said accumulator chamber and said second balancing chamber.

1 2. The hermetically sealed pressure-balanced accumulator of claim 1 in
2 which said hermetic sealing device for sealing said first balancing chamber includes a
3 first bellows device.

1 3. The hermetically sealed pressure-balanced accumulator of claim 2 further
2 including a hermetic sealing device for sealing said second balancing chamber from said
3 accumulator chamber.

1 4. The hermetically sealed pressure-balanced accumulator of claim 3 in
2 which said hermetic sealing device for sealing said second balancing chamber includes a
3 second bellows device.

1 5. The hermetically sealed pressure-balanced accumulator of claim 4 in
2 which said movable divider mechanism separates said housing into said first balancing
3 chamber, said second balancing chamber, said accumulator chamber, and a third balancing
4 chamber, said third balancing chamber is pressurized to provide said accumulator chamber
5 with said pre-selected accumulator pressure.

1 6. The hermetically sealed pressure-balanced accumulator of claim 5 further
2 including a hermetic sealing device for sealing said third balancing chamber from said
3 accumulator chamber.

1 7. The hermetically sealed pressure-balanced accumulator of claim 6 in
2 which said hermetic sealing device for sealing said third balancing chamber includes a
3 third bellows device.

1 8. The hermetically sealed pressure-balanced accumulator of claim 7 in
2 which said first, second and third bellows devices include welded metal bellows.

1 9. The hermetically sealed pressure-balanced accumulator of claim 1 in

2 which said accumulator chamber is a hydraulic fluid chamber for storing hydraulic fluid.

1 10. The hermetically sealed pressure-balanced accumulator of claim 1 in
2 which said movable divider mechanism is a piston for responding to ambient pressure
3 changes in said first balancing chamber.

1 11. The hermetically sealed pressure-balanced accumulator of claim 5 in
2 which said movable divider mechanism includes first and second pistons connected by a rod
3 for responding to ambient pressure changes in said first balancing chamber.

1 12. The hermetically sealed pressure-balanced accumulator of claim 5 in
2 which said third balancing chamber includes pressurized fluid.

1 13. The hermetically sealed pressure-balanced accumulator of claim 12 in
2 which said pressurized fluid is a gas.

1 14. The hermetically sealed pressure-balanced accumulator of claim 12 in
2 which said pressurized fluid is a liquid.

1 15. The hermetically sealed pressure-balanced accumulator of claim 5 in
2 which said third balancing chamber includes a spring device.

1 16. The hermetically sealed pressure-balanced accumulator of claim 1 in

2 which said first balancing chamber includes a fluid.

1 17. The hermetically sealed pressure-balanced accumulator of claim 16 in
2 which said fluid is a liquid.

1 18. The hermetically sealed pressure-balanced accumulator of claim 16 in
2 which said fluid is a gas.

1 19. The hermetically sealed pressure-balanced accumulator of claim 1 in
2 which said second balancing chamber is sealed.

1 20. The hermetically sealed pressure balanced accumulator of claim 1 in
2 which said second balancing chamber includes a gas chamber at a pressure lower than
3 ambient pressure.

1 21. The hermetically sealed pressure balanced accumulator of claim 1 in
2 which said second balancing chamber includes a liquid chamber at a pressure lower than
3 ambient pressure.

1 22. The hermetically sealed pressure balanced accumulator of claim 1 in
2 which said second balancing chamber is a vacuum.

1 23. The hermetically sealed pressure balanced accumulator of claim 1 in

2 which said second balancing chamber includes a spring device.

1 24. The hermetically sealed pressure-balanced accumulator of claim 5 in

2 which said third balancing chamber is sealed.

1 25. A hermetically sealed pressure-balanced accumulator comprising:
2 a housing; /
3 a movable divider mechanism for separating said housing into a gas
4 chamber, a liquid chamber, and an accumulator chamber;
5 a first bellows device for hermetically sealing said gas chamber from said
6 accumulator chamber; and
7 a second bellows device for hermetically sealing said liquid chamber from
8 said accumulator chamber.

1 26. A hermetically sealed pressure-balanced accumulator comprising:
2 a housing;
3 a movable divider mechanism including first and second pistons
4 connected by a rod for separating said housing into an accumulator chamber at an
5 accumulator pressure, a first gas chamber pressurized to a pressure higher than ambient
6 pressure for providing said accumulator chamber with accumulator pressure, a liquid
7 chamber responsive to changes in ambient pressure for adjusting said accumulator
8 pressure with respect to ambient pressure, and a second gas chamber at a pressure lower
9 than ambient pressure responsive to said liquid chamber, said liquid chamber and said
10 first and second gas chambers thereby maintaining a predetermined differential between
11 said accumulator pressure and ambient pressure;
12 a first bellows device for hermetically sealing said higher pressure gas
13 chamber from said accumulator chamber; and
14 a second bellows device for hermetically sealing said fluid chamber from
15 said lower pressure gas chamber.

1 27. A hermetically sealed pressure-balanced accumulator comprising:
2 a housing;
3 a divider mechanism for separating said housing into at least first and
4 second balancing chambers and an accumulator chamber; and
5 a hermetic sealing device for sealing said first balancing chamber from said
6 accumulator chamber.

1 28. The hermetically sealed pressure-balanced accumulator of claim 27 in
2 which said hermetic sealing device includes a bellows.

1 29. The hermetically sealed pressure-balanced accumulator of claim 27 in
2 which said first balancing chamber includes a fluid chamber for applying pressure to said
3 divider mechanism.

1 30. The hermetically sealed pressure-balanced accumulator of claim 29 in
2 which said fluid chamber includes a gas.

1 31. The hermetically sealed pressure-balanced accumulator of claim 29 in
2 which said fluid chamber includes a liquid.

1 32. The hermetically sealed pressure-balanced accumulator of claim 27 in
2 which said second balancing chamber includes a fluid chamber.

1 33. The hermetically sealed pressure-balanced accumulator of claim 32 in
2 which said second balancing chamber includes a gas.

1 34. The hermetically sealed pressure-balanced accumulator of claim 32 in
2 which said second balancing chamber includes a liquid.

1 35. The hermetically sealed pressure-balanced accumulator of claim 27 in
2 which said accumulator chamber includes a hydraulic fluid chamber for holding hydraulic
3 fluid.

1 36. The hermetically sealed pressure-balanced accumulator of claim 27 in
2 which said divider mechanism includes a piston for responding to pressure changes in said
3 first balancing chamber.

1 37. The hermetically sealed pressure-balanced accumulator of claim 28 further
2 including a second hermetic sealing device for sealing said second balancing chamber
3 from said accumulator chamber.

1 38. A hermetically sealed pressure-balanced accumulator comprising:
2 a housing;
3 a divider mechanism for separating said housing into first, second and third
4 balancing chambers and an accumulator chamber;
5 a first hermetic sealing device for sealing said first balancing chamber from
6 said second balancing chamber; and
7 a second hermetic sealing device for sealing said third balancing chamber
8 from said accumulator chamber.

1 39. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said first hermetic sealing device includes a first bellows device.

1 40. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said second hermetic sealing device includes a second bellows device.

1 41. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said first balancing chamber includes a fluid chamber for applying pressure to said
3 divider mechanism.

1 42. The hermetically sealed pressure-balanced accumulator of claim 41 in
2 which fluid chamber is a gas chamber.

1 43. The hermetically sealed pressure-balanced accumulator of claim 41 in
2 which fluid chamber is a liquid chamber.

1 44. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said second balancing chamber includes a low pressure fluid chamber.

1 45. The hermetically sealed pressure-balanced accumulator of claim 43 in
2 which said low pressure fluid chamber includes a gas.

1 46. The hermetically sealed pressure-balanced accumulator of claim 43 in
2 which said low pressure fluid chamber includes a liquid.

1 47. The hermetically sealed pressure-balanced accumulator of claim 43 in
2 which said second balancing chamber is a vacuum.

1 48. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said third balancing chamber includes a pressurized fluid chamber.

1 49. The hermetically sealed pressure-balanced accumulator of claim 48 in
2 which said pressurized fluid chamber includes a gas.

1 50. The hermetically sealed pressure-balanced accumulator of claim 48 in
2 which said pressurized fluid chamber includes a liquid.

1 51. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said accumulator chamber includes a hydraulic fluid chamber for holding hydraulic
3 fluid.

1 52. The hermetically sealed pressure-balanced accumulator of claim 38 in
2 which said divider mechanism includes first and second pistons connected by a rod for
3 responding to pressure changes in said first balancing chamber.